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AN APPLICATION OF REFRIGERATION

By JOHN W. LAYTON, '30



EARLY every modern home contains an electric refrigerator and yet very few of us know the principles involved. We hardly give it a thought, as it is automatic and needs no care excepting an oiling every six months. As long as it keeps our food cold, freezes our desserts, and provides our cubes for cold drinks, we do not consider it further. On the other hand, if it should fail in the satisfactory performance of its duties, very few of us would know where to look for the trouble.

There are many kinds of plants manufactured, using many different kinds of refrigerants.

One refrigerant that is widely used is sulphur dioxide, which has a boiling point of 14°F . A tumbler of sulphur dioxide will boil violently when exposed to air at normal room temperatures. Apparently no heat is being supplied to the tumbler of sulphur dioxide. However, heat is actually being supplied by the surrounding air, which in the case of the sulphur dioxide is sufficient to make it boil.

Briefly, the principle of mechanical refrigeration is to place a liquid which will boil at a temperature lower than the surrounding atmosphere in a system of coils where it can be controlled. Then surround the coils with insulated walls to keep out the heat, and the result will be that as the liquid evaporates the insulated compartments will be cooled noticeably.

The boiling point of the refrigerant usually takes place in a system of coils designed to quickly transfer the heat from the surrounding air to the copper coils and then to the refrigerant. The system of coils is known as the cooling unit.

In order to use over and over again, the refrigerate, the gas resulting from the absorption of heat must be put back into a liquid state again. This is accomplished by a process known as condensing.

To illustrate: sulphur dioxide will boil at 14°F . at atmospheric pressure, while it requires 90°F . to boil it when the pressure is increased to 55 pounds. At 55 pounds pressure the temperature of the gas will be higher than the temperature of the cooling medium, therefore heat will flow from the warm gas to the cooling medium and the gas will condense back to a liquid.

Briefly the cycle of operation is as follows:

The heat leaks through the insulation in the box, through the doors or is carried in with the food into the cabinet. The air circulating within the cabinet carries the heat to the cooling unit. As the cooling unit absorbs this heat, some of the refrigerate in the cooling unit vaporizes. This gas, laden with the heat absorbed from the food compartment, is drawn down by the motor-driven compressor through a copper tube and is compressed until its temperature is above that of the cooling medium. The heat is then transferred to the cooling medium and the gas is condensed to a liquid. The liquid refrigerant flows into the compressor whence it is forced by pressure derived from the compressor, through a copper tube to the cooling unit where it is used again.

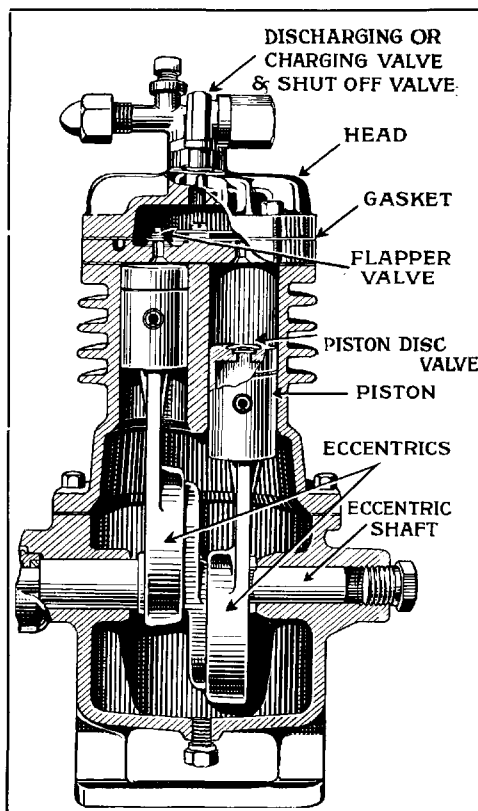
In order that a refrigerating system shall operate properly, just the right amount of refrigerant must be supplied to the cooling unit at the proper time.

In large refrigerating plants this is accomplished by means of a hand-operated valve. The engineer who is constantly on hand to watch his regulating instruments, regulates the supply of refrigerating liquid according to the conditions. In the small domestic refrigerators this controlling must be done automatically.

Many systems use a differential pressure valve which operates according to the difference in pressure outside and

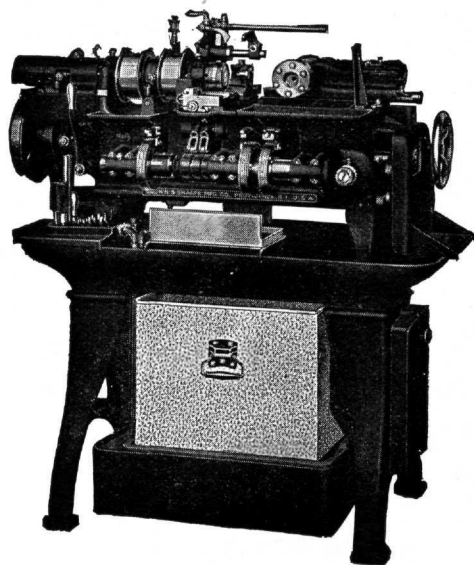
inside the cooling unit. Another method is by means of a float valve. This valve is placed in the header of the cooling unit and operated similar to a carburetor float valve. It maintains a proper level of sulphur dioxide in the cooling unit at all times regardless of surrounding temperatures. As the sulphur dioxide vaporizes, the liquid level lowers, thus permitting additional liquid refrigerant to enter the cooling unit. As the level rises, the float rises and finally shuts off the supply. You can readily see from this that the control is dependent only upon the height of liquid in the cooling unit which in turn is dependent upon the rapidity with which the liquid boils or evaporates.

The cooling unit is made up of a header in which the temperature control mechanism is



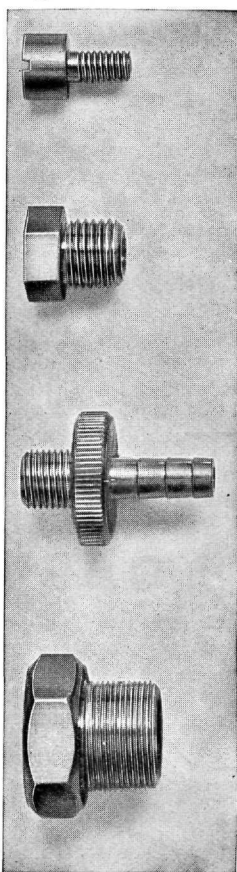
—Courtesy Frigidaire Corp.
Cross-Section of a Compressor

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AN APPLICATION OF REFRIGERATION

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placed and a system of coils designed to bring about the most efficient transfer of the heat from the air to the refrigerant contained within the coils. This cooling unit is not just a coil of pipe or tubing, but has a very definite shape and form because of the particular function which it has to serve.

One of the greatest difficulties in the development of small refrigerating systems is to secure the proper return of the oil from the cooling unit to the compressor. The compressor, which is similarly designed to an internal combustion engine, must be lubricated so as to eliminate the friction between the pistons and the cylinders. The oil must also make a more perfect seal between the piston and the cylinder to prevent leaking of gas. It is inevitable that a portion of this oil will be scrubbed up through the cylinders into the condensing chamber, just as oil is pumped up from the crank case through the cylinders in an automobile engine.

If this process continues long enough in a refrigerator compressor, and if the oil is not returned to the crank case, the latter will run dry and the evaporating coils will become over-supplied with oil which will stop or partly stop the circulation of the refrigerant in the coils, thus preventing refrigeration.

Fortunately sulphur dioxide and oil have an affinity for each other. When sulphur dioxide is condensed and comes in contact with the oil which has been scrubbed up through the cylinders from the crankcase, it absorbs a part of this oil so that the resulting liquid which passes up to the boiler is not pure sulphur dioxide but is a solution of oil absorbed in sulphur dioxide. Some provision is, therefore, necessary to return the oil from the top of the cooling unit to the compressor.

When the solution of sulphur dioxide and oil in the cooling unit boils or evaporates we have a case of distillation. The sulphur dioxide passes off to the crankcase in the form of gas, leaving the oil behind. The oil is lighter than sulphur dioxide and therefore floats on top of it. When the oil reaches the drain holes, which are appropriately provided, it overflows into the holes and passes down through the suction pipe back to the crankcase.

STENOGRAPHERS

Stenographers are an important item in every office. They are usually either blonde or brunette. Seemingly there can be no variations between the two limits. We have approached several aspiring Chemical Engineers in regard to this problem. They state that they expect to have in the near future some preparation which will be capable of turning out all variations between the true blondes and brunettes. This should be very desirable, since it would greatly aid in the artistic color schemes used in our modern offices. What, for instance, could be more outstanding than a black walled office peopled with three shades of blondes? This would be a valuable aid in developing the esthetic sense of the young engineer who finds himself working in an office with one or more stenographers.

—ROSE "RADIO."